



Can a technology give you a performance benefit for workstations?

Yes. Hyper-Threading Technology is groundbreaking technology from Intel that enables the processor to execute threads or tasks in parallel, delivering significant performance boosts for workstations.

The Intel® Xeon™ Processor

Hyper-Threading Technology from Intel delivers significant performance benefits today in a broad range of workstation applications and environments for dual-processor workstation platforms based on the Intel® Xeon™ processor and is supported by the Intel® E7505 chipset. This innovative technology is available throughout the Intel® Xeon™ processor family for both servers and workstations.

For Demanding Performance and Mid-range Applications

For demanding mid-range applications, Hyper-Threading Technology on the Intel Xeon processor-based platform is the ideal workstation engine, delivering:

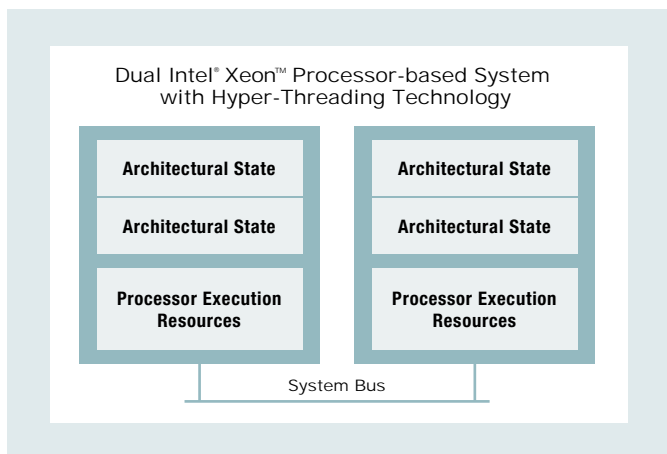
- **Up to 37% performance** increase for multitasking usage models
- **Improved performance** for an increasing number of workstation workloads and usages today
- **Up to 27% performance** increase for multithreaded applications in 3D Content Creation and Digital Media
- **Faster response** and increased throughput for multitasking environments, enabling improved business productivity



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Designed for demanding performance and mid-range workstation applications.



Overview of Hyper-Threading Technology

Hyper-Threading Technology is an on-processor innovation whereby multiple threads of software applications, or multiple tasks from one or more applications, can be run simultaneously on one processor. This is achieved by duplicating the architectural state on each processor, while sharing one set of processor execution resources. The architectural state tracks the flow of a program or thread, and the execution resources are the units on the processor that do the work: add, multiply, load, etc.

What is Hyper-Threading Technology for Workstations?

Hyper-Threading Technology from Intel delivers performance boosts in both multithreaded applications (DP) and multitasking usages and workloads (DP and UP).¹

By utilizing processor on-die resources that would otherwise have been idle, Hyper-Threading Technology provides a performance boost on multithreading and multitasking operations for the Intel® NetBurst™ microarchitecture. More efficient use of processor resources delivers improved performance.

Immediate Productivity Increases for Today's Businesses

With processor and application parallelism becoming more prevalent, many of today's platforms are increasingly turning to threading as a way of increasing overall system performance. At the same time, in today's business environments a multitasking environment is the norm. Hyper-Threading Technology enables the most demanding users to work faster when multitasking – even with processor-intensive applications. Additionally, Hyper-Threading Technology minimizes the impact of background services such as encryption, virus scanning and compression on end-user productivity.

Hyper-Threading Technology Provides Value to End Customers by Increasing Headroom

For typical workstation workloads, it requires more than just raw compute power to minimize impacts to background tasks. The Intel Xeon processor provides the performance headroom end users need to run multiple complex applications simultaneously with minimal delays to response time.

Changing the landscape of processor design and performance, Hyper-Threading Technology – available only on Intel® microprocessors – complements dual processing by providing additional headroom for future software. Many applications are being developed today that maximize the performance benefits of Hyper-Threading Technology for both multithreading and multitasking. Simply stated, Hyper-Threading Technology delivers higher performance for workstations.

Multitasking Benefits

Compatible with existing IA-32 software, workstations based on the Intel Xeon processor with Hyper-Threading Technology take advantage of multitasking features in today's operating systems and applications – so new software is not required.

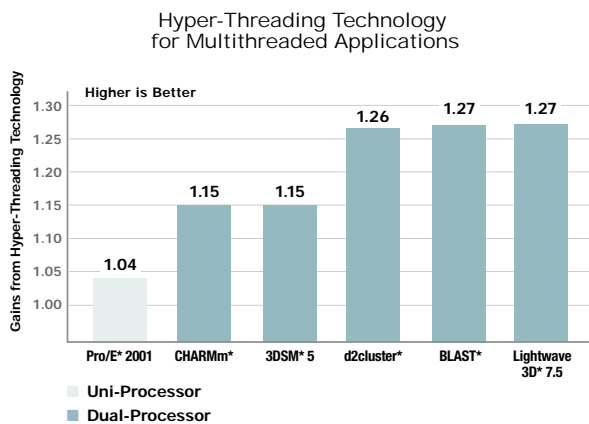
Multithreading Benefits

The demand for performance DP workstation applications that use Intel® processors with Hyper-Threading Technology will continue to significantly increase over time to maximize performance for multithreaded applications. While multithreaded applications are available today, software vendors will continue to work with Intel to deliver optimizations on different suites of multithreaded software, enabling industry-leading performance.

Industry Readiness and Availability

While Intel processors with Hyper-Threading Technology are compatible with today's applications, the software industry continues to optimize OS and applications for continual performance improvements in both multithreading and multitasking workloads. Intel has worked with operating system vendors to include optimizations for the Intel NetBurst microarchitecture and Hyper-Threading Technology in today's high-performing OS: Microsoft Windows® XP and Linux® operating systems.³

Hyper-Threading Technology Delivers Significant Performance Increases in Multithreaded Workstation Applications and Multitasking Workloads.



- Comparison of 2p configurations in a dual processor system with Hyper-Threading Technology enabled and disabled
- Immediate benefits on some applications today
- Headroom for tomorrow's optimized applications

System Configurations

Source: Intel Corporation

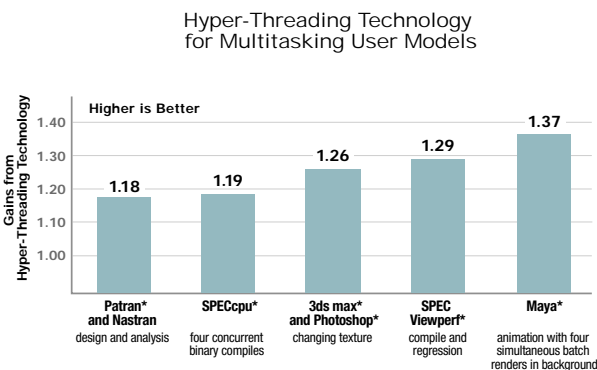
With and without Hyper-Threading Technology on the following system configuration: Intel® Xeon™ Processor 2.80 GHz/533 MHz system bus with 512KB L2 cache, Intel® E7505 chipset-based Pre-Release platform, 1GB PC2100 DDR CL2 CAS2-2-2, (2) 18GB Seagate Cheetah® ST318452LW 15K Ultra160 SCSI hard drive using Adaptec® 39160 SCSI adapter BIOS 3.10.0, nVidia® Quadro4 Pro 980XGL 128MB AGP 8x graphics card with driver version 40.52, Windows® XP Professional build 2600.

Multithreading for Applications

Hyper-Threading Technology provides a performance boost for multithreaded workstation applications.

Multithreading allows an application to execute multiple threads at the same time. Hyper-Threading Technology is a form of simultaneous multithreading technology, where multiple threads from workstation applications can be run simultaneously on each processor within the workstation. This is made possible by duplicating the processor's architectural state, but continuing to provide only one set of shared processor execution resources.

Each architectural state is called a "logical processor," and the operating system uses the two logical processors to track program execution for two different software threads simultaneously. The first logical processor tracks one thread, while the other logical processor tracks a second thread simultaneously. Because the two threads share one set of execution resources, the second thread can use execution resources that would otherwise be idle if only one thread was executing. The result is an increased utilization of the execution resources within each physical processor package. Application examples include: Discreet/ 3D Studio Max*, Alias/Wavefront*/ Maya*, Pam CRASH*, LS-DYNA* (crash), and Pixar.*



- Performance gains whether running multiple tasks within one application or multiple applications running at once.
- More responsive system while background tasks complete
- Headroom when performing compute-intensive tasks

System Configurations

Source: Intel Corporation

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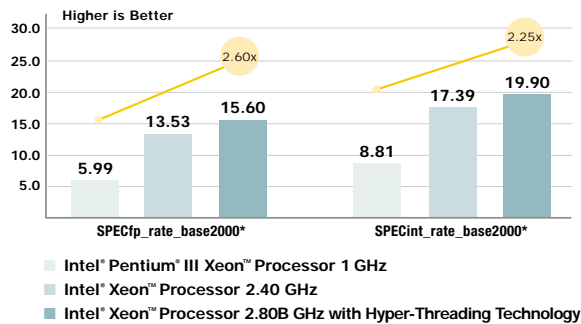
Multitasking Workloads

Hyper-Threading Technology provides significant performance gains for users who perform multiple tasks.

Multitasking allows two or more programs or tasks to execute simultaneously and/or alternate between them. While any modern processor can run multiple applications at once, with Hyper-Threading Technology, each application utilizes the processor's duplicated architectural state, but continues to share only one set of processor execution resources. As with the multithreading benefits described, the end user is allowed to effortlessly alternate between multiple bandwidth-intensive programs or tasks without impacting the performance of the application because idle execution resources are utilized.

Workload examples include: Parallel Compilation, Multiple Maya Scene Renderings, and Excel Monte Carlo* Analysis.

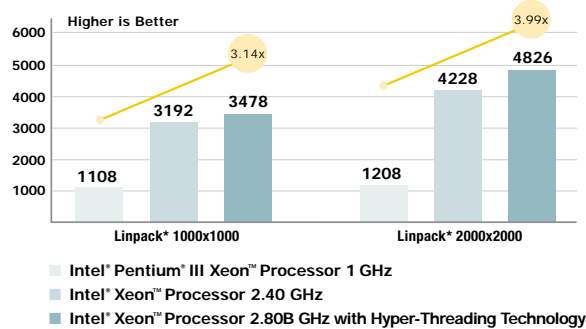
Floating-point and Integer Calculations Dual-processor SPECcpu2000* Performance



Floating Point and Integer Calculations Outstanding floating point and integer capability for compute-intensive workstation applications

Platform advancements on the Intel Xeon processor supporting Hyper-Threading technology enhance your productivity through increased responsiveness and faster calculations when performing compute intensive tasks on a broad range of applications. Overall rapid analysis and compilations results in an up to 2.25x improvement on integer and a 2.60x improvement on floating point calculations.

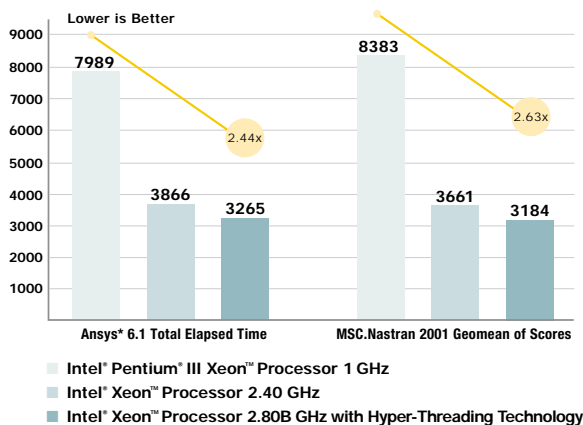
Scientific/Technical Computing Dual-processor Linpack* Performance



Scientific/Technical Computing Delivering performance horsepower to solve complex high performance computing workloads

Intel Xeon processor has the headroom you need to handle multiple scientific simulations at once. With platform advancements including Hyper-Threading Technology you get a greater advantage on solving larger problem sizes and equations. Delivering performance for large matrices calculations and large technical computing problems, this results in up to 3.99x more mathematical equations solved.

Mechanical Computer-aided Engineering Dual-processor MCAE Performance Comparison



Mechanical Computer-aided Engineering Outstanding performance and headroom for compute-intensive structural and mechanical analyses

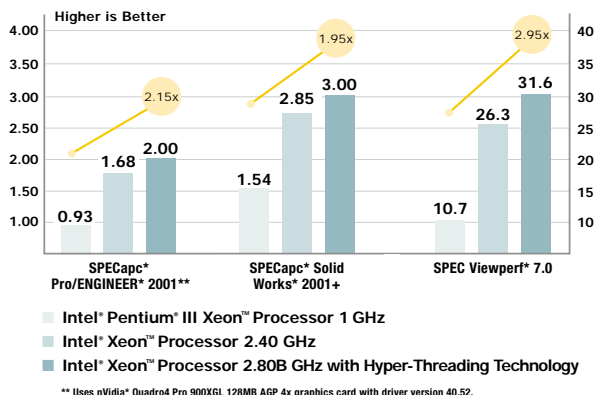
With platform advancements on the Intel Xeon processor including Hyper-Threading Technology you benefit from overall faster analysis of large models resulting in shorter product design lifecycles. With headroom to handle multiple simultaneous analyses, the Intel Xeon processor measures system ability to perform simulations of both structural and mechanical analyses delivering up to 2.63x faster analysis time for linear and non-linear models.

System Configurations

Source: Intel Corporation

- Pentium® III Xeon™ 1 GHz/133 MHz system bus, Intel® 840 chipset-based platform, 1GB PC800 RDRAM, (2) 18GB Seagate Cheetah® ST318452LW 15K Ultra160 SCSI hard drive using Adaptec® 39160 SCSI adapter BIOS 3.10.0, nVidia® Quadro4 Pro 980XGL 128MB AGP 8x graphics card with driver version 40.52, Windows® XP Professional build 2600.
- Intel® Xeon™ Processor 2.40 GHz/400 MHz system bus with 512KB L2 cache, Intel® 860 chipset based Dell Precision® Workstation 530, 1GB PC800 RDRAM, (2) 18GB Seagate Cheetah ST318452LW 15K Ultra160 SCSI hard drive using Adaptec 39160 SCSI adapter BIOS 3.10.0, nVidia Quadro4 Pro 980XGL 128MB AGP 8x graphics card with driver version 40.52, Windows XP Professional build 2600.
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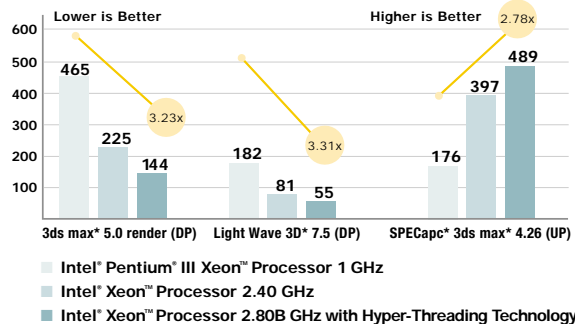
3D Mechanical CAD Uni-processor MCAD Performance Comparison



3D Mechanical CAD Excellent performance capability for intense 3D CAD operations

The Intel Xeon processor measures system ability to display and manipulate various mechanical models resulting in an up to 2.95x faster modeling of complex designs. The advanced platform of the Intel Xeon processor including Hyper-Threading Technology gives you quicker rendering of 3D images and faster development of 3D rendered mechanical models, allowing you to do more in less time with improved analysis through faster data visualization.

Digital Content Creation DCC Performance Comparison



Digital Content Creation Great rendering ability and improved productivity for digital content creation professionals

With the Intel Xeon processor you'll find the headroom you need to allow increased responsiveness while rendering. This advanced platform with Hyper-Threading Technology measures rendering time of complex digital designs resulting in up to 3.23x faster rendering, giving you faster creation of realistic 3D content for character animation, next-generation game development, and visual effects production. With reduced product design lifecycle timelines, you can do more in less time.

System Configurations

Source: Intel Corporation

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Summary

Hyper-Threading Technology is a groundbreaking technology that Intel has seamlessly integrated into today's industry-standard workstation infrastructure via the Intel Xeon processor supporting Hyper-Threading Technology.

Today's UP and DP operating systems and threaded workstation applications can run unchanged on the Intel Xeon

processor, and many can take advantage of Hyper-Threading Technology for immediate business benefits. Hyper-Threading Technology complements today's DP and UP workstations by providing additional headroom for future growth and new workstation capabilities on the horizon. Today's and tomorrow's businesses can utilize the Intel Xeon processor supporting Hyper-Threading Technology for a competitive advantage.

For More Information

Contact your Intel® products representative to discover how workstations based on both the Intel Xeon processor and the Intel E7505 chipset can enhance your business productivity.

Or, visit the Intel® Business Computing Web site at:

<http://www.intel.com/eBusiness/products/workstation>

For information about Intel® e-Business products and technologies, visit the Intel Business Computing Web site at:

<http://www.intel.com/eBusiness>

1. To find out more information about UP workstation platforms and the Intel® E7205 chipset optimized for the Intel® Pentium® 4 processor and Hyper-Threading Technology, refer to Intel® E7205 Sales Brief (part number: 251803-001).

2. The Linux® operating system from a number of vendors is available for the Intel Xeon processor with 533 MHz system bus and supports Hyper-Threading Technology. Contact your Linux vendor for more information.

3. Intel recommends Hyper-Threading Technology is disabled through the BIOS for workstations running legacy operating systems.

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Look for systems with the Intel® Pentium® 4 Processor with Hyper-Threading Technology logo which your system vendor has verified utilize Hyper-Threading Technology. Performance will vary depending on the specific hardware and software you use. See www.intel.com/info/hyperthreading for information.¹ Note: Only exception is Intel® 845G A-stepping which does not support Hyper-Threading Technology.

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The Intel Xeon processor may contain design defects or errors known as errata which may cause the product to deviate from published specifications. Current characterized errata are available on request.

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